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[Grass and Forage-Plant Investigations.]

F. LAMSON-SCRIBNER, *Agrostologist.*

GRASSES AND FODDER PLANTS ON THE POTOMAC FLATS.

During the past summer the Division of Agrostology has grown a large variety of native and imported grasses and fodder plants upon the island in the Potomac River, which is just south of the city of Washington and locally known as the "Potomac Flats." The soil consists of dredgings from the river bed and is very rich. It is an ideal place for growing the coarser annual fodder plants and has afforded an interesting field for studying the new perennial grasses and clovers, both of native varieties and those imported from foreign countries through the Section of Seed and Plant Introduction of this Department and grown here for the first time. The behavior of a number of grasses from our Southwestern States and Territories is especially worthy of note.

Curly mesquite, from the plains of Texas and Arizona, made a wonderful growth and produced a large crop of seed; turnip grass, from New Mexico, made a surprisingly rich growth and seeded heavily; water grass exhibited a growth which maintains for it all the claims which have been made respecting its forage value; and sprangle, a native of Texas and regions west of that State, promises to be one of the most productive and finest hay grasses grown on our trial grounds. A number of species from Australia have manifested a ready adaptability to our climatic conditions and on the soil of the Flats grew finely. Button grass from the interior plains of South Australia grew with remarkable vigor and seeded most abundantly. It is not unlikely that this grass may have high value for portions of the warmer and drier regions of the Southwest. Mitchell grass, another Australian species, regarded by stockmen in the interior of New South Wales as one of the best of all native grasses both for its drought-enduring qualities and its fattening properties, made a vigorous growth and appeared to be perfectly at home in its new surroundings. Bermuda grass, the king of pasture grasses for the South, grew readily from seed sown early in the season and made a most luxuriant growth, the mass of leaves and stems covering the ground knee-deep with a rich bed of pasturage. A number of the Australian saltbushes grew finely and showed great possibilities for forage production of their class. The growth of the clovers and alfalfa was inferior compared with that of the grasses, but the vetches and different varieties of peas and beans succeeded well, while such plants as Kafir corn, several varieties of pearl millet and teosinte grew with great vigor and yielded an astonishing amount of forage, especially the last named. A detailed report by Mr. C. R. Ball, assistant in the Division, who had charge of the work of the Division on the Flats, is here presented and its publication recommended, not only for the interest attached to the several species cultivated, but to place the work on record.—F. LAMSON-SCRIBNER.

INTRODUCTION.

The experiments noted herein are exclusive of those made in the grass garden on the grounds of the Department, and relate wholly to the work done on about 4 acres of land on the Potomac Flats. These 4 acres constitute a part of an area of some 22 acres, which has been used during the past season by several divisions in the Department for conducting experiments with plants and vegetables, and which was primarily set apart for the use of the Division of Botany. The land in question is on an island just south of Washington, D. C., near Long Bridge, and was originally a tidal marsh. Its present condition is the result of dredging out the channel between it and the main land, now forming the city water front, and pumping the mud over upon the marsh. The surface was thus raised from two to ten feet above high tide. This work was done by the War Department, and the use of the land by the Agricultural Department was through permission of the Secretary of War. The land is exceedingly rich, being the city drainage and harbor deposit of many years' accumulation.

On the higher, well-drained areas the soil is loose and porous, washing badly with heavy rains, but on the lower portions it forms a hard surface crust as it dries after having been packed by floods. As might be expected from the origin of the island, the subsoil is very porous, so much so that the surface water frequently breaks suddenly through the firmer upper crust into subterranean cavities, new openings of this character being apparent after every heavy rain. It will be readily seen that the soil is peculiar to the island, and can in no way be considered typical of this or any other region. This fact does not especially injure its value for comparative experiments.

The ground was cleared and plowed in the spring of 1899 and fallowed during that season. In the late fall it was plowed three times, at intervals of about three weeks, and left rough over winter. In the spring of the present year an Acme harrow was used frequently, being run over the field in both directions to keep down the weeds. Ever since the formation of the land some ten years ago, weeds have been growing and seeding unrestrained, and they covered the surface with a dense and luxuriant growth. On the higher part the most abundant were sweet elder (*Sambucus Canadensis* L.), velvet leaf (*Abutilon Avicennae* Gaertn.), lamb's quarter (*Chenopodium album* L.), purslane (*Portulaca oleracea* L.), and morning glory (*Convolvulus sepium* L.) On the low ground, wormseed (*Chenopodium anthelminticum* L.), and a species of heartsease or smartweed (*Polygonum*) were so abundant and so vigorous as to call forth the most strenuous efforts to prevent their

choking the young forage plants entirely. A constant warfare was waged on the pests during the entire season, and it is to be hoped that they will prove less troublesome another year.

For several reasons the conditions under which the experiments of this year were carried out were far from satisfactory, a fact which gives greater value to the good results obtained and no doubt explains some of the failures, partial or entire. Work was not begun until the end of April, and was then greatly retarded by a lack of assistance and equipment, due to the insufficiency of the appropriation which could be used for that purpose. The months of May and June were very wet, as will be seen from the following rainfall tables:

Daily precipitation at Washington, D. C., from April to November, 1900.

(Data furnished by the U. S. Weather Bureau.)

| Date. | April. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. |
|-------|--------|------|-------|-------|------|-------|----------------|------|
| 1 | | | .08 | | | | .30 | .06 |
| 2 | | | 3.48 | | | | T ¹ | T |
| 3 | | .21 | | | | | .01 | .75 |
| 4 | .04 | | | .04 | | T | .01 | |
| 5 | | | | T | .35 | | T | |
| 6 | | | | T | | | | |
| 7 | T | | | .03 | | | T | |
| 8 | | | 2.84 | | | | .44 | .34 |
| 9 | | .41 | | | | .02 | T | .25 |
| 10 | | | | | | | | |
| 11 | .03 | T | | | | .03 | | |
| 12 | .53 | T | .17 | T | .08 | | | |
| 13 | T | | .78 | .01 | .08 | | .19 | |
| 14 | | | .56 | | | .19 | .23 | |
| 15 | | | .03 | | | 1.27 | | |
| 16 | | | 1.00 | | .07 | 1.68 | | |
| 17 | .02 | | 1.68 | | .04 | | | |
| 18 | .68 | .01 | | | | | | T |
| 19 | .12 | 3.15 | T | .14 | | | | |
| 20 | | T | | .40 | .13 | | | T |
| 21 | .22 | | T | | .38 | T | | .01 |
| 22 | .01 | | | .19 | T | | | T |
| 23 | .09 | | | T | .11 | .07 | .06 | |
| 24 | | .14 | T | | .87 | | .20 | .81 |
| 25 | | .04 | .08 | .08 | .07 | | | .12 |
| 26 | | | .24 | .32 | | | | .31 |
| 27 | | | T | | | T | | |
| 28 | | T | | | .15 | 1.06 | | |
| 29 | | .06 | | | | | | |
| 30 | | | T | .04 | | .29 | | |
| 31 | | T | | | | | | |
| Total | 1.74 | 4.02 | 10.94 | 1.25 | 2.28 | 4.61 | 1.44 | 2.15 |

¹ "T" as used throughout this table denotes a trace of rainfall.

The extremely heavy rains of May 19, June 2, and June 8 did much damage. The first one, coming after the planting of a large part of the higher ground, fell with such rapidity and violence as to wash away both seed and soil from some plats and mix the seed on several others so thoroughly as to entirely vitiate their integrity and necessitate replanting. Each of these rains covered the lower field with standing water several inches deep, which drained away but slowly from the level land or sloping in from the river. This seriously delayed the planting on that area.

During July and August the weather was very hot and dry, affording excellent opportunity to observe the drought-resisting properties of the various crops. Some very interesting results were obtained in this connection. Many of the plats, however, had been sown so late that the young plants had not become firmly established before they were overcome by the arid conditions which followed. A large number managed to just about hold their own during those months and afterward made a good growth.

The land allotted to this Division was divided by a roadway into two nearly equal fields, numbered 9 and 10. Each field was then laid out into plats a rod square, with paths 2 feet wide running in both directions. There were about 480 of these plats. Each row of plats running lengthwise of the field was given a series letter, A, B, C, etc., and the plats in each series were numbered consecutively. The first of the series in field 9 would thus be 9—A—1, the second 9—A—2, and so on for row A. The plats in the next row would be 9—B—1, 9—B—2, etc. The same scheme was used for field 10.

PERENNIAL MEADOW AND PASTURE GRASSES.

About 150 plats were devoted to experiments with grasses other than the millets and sorghums. Quite a large number of those sown earliest were rendered valueless for test purposes by a heavy rain falling just after seeding, washing away a large amount of seed and mixing some of the remainder. This was most unfortunately the case in a series containing 25 brome grasses, from which much in the way of comparative results had been hoped. No report is made here on several of our common cultivated grasses, such as red tops, orchard grass, etc., which were included in the experiment. These are well known perennials, and may better be reported on in another season.

Bermuda grass (*Cynodon Dactylon* (L.) Pers.).—This plat was intended to demonstrate that Bermuda could be profitably started from seed, and it was a complete success. The seed was from the Division supply, purchased in 1899, and was planted June 6 at the rate of 20 pounds per acre. By the middle of July there was an abundance of the creeping stems 3 to 6 inches long. Two weeks later the plat presented a luxuriant mass of foliage about 4 inches high. On the 20th of August the creeping branches covered the ground completely for a distance of 2 or 3 feet on all sides of the plat, which was a dense mass of grass 12 to 18 inches high, and was ready for cutting. The sides of the plat were now cut back to their original position. Two months later, on October 20, the foliage was still soft, luxuriant, and perfectly healthy, while the creeping stems had again reached a length of 4 feet. Had the plat been cut for hay at the time the stems were cut back it would have been ready for a second cutting before this date. Pieces of the stem trimmed off in August had covered the entire surface of an adjacent vacant plat with wiry stems which have as yet produced few leaves. Several severe frosts during the first two weeks of November killed most of the foliage.

As stated, this plat was seeded at the rate of 20 pounds per acre, which is 2 or 2½ times as thick as is generally recommended. The resulting growth was very thick, much thicker than was necessary to secure a good stand and an abundant hay crop. At the rate of 8 pounds per acre, with seed costing 75 cents per pound, the expense per acre is only \$6. This ought, with well prepared soil and careful seeding, to result in a good hay crop, free from weeds, the same season. The ordinary method of planting the roots, while primarily less expensive, usually results in a weedy field, with little or no crop the first year. Where seed is used, the difference in amount of hay or pasturage obtained the first year should more than pay for the seed.

Turnip grass (*Panicum bulbosum* H. B. K.).—Two square rods were planted on June 6 with seed raised in the grass garden in 1899. In five weeks the plants reached a height of about 6 inches, of vigorous growth and a beautiful glaucous color. By the end of July they were nearly 1½ feet in height, and this rapid, sturdy growth was maintained throughout August. Early in September the grass flowered at a height of about 5 feet, the seeds in the large open panicles ripening by October 1, and 9 pounds were gathered on the 5th. By the 20th of October the plants, still green and vigorous, began putting out small lateral panicles to replace the large ones cut for seed.

An adjacent plat, planted with seed from what was called *Panicum avenaceum*, proved identical with the above in every respect.

This grass makes a very rapid, vigorous growth, and, if planted thickly and cut before maturing, it should yield an abundance of excellent hay. It promises to be of great value in the Southwest and possibly also for other sections. Its luxuriant growth on the "Flats" was hardly more striking than that in the poorer soil in the grass garden on the Department grounds.

Sprangle (*Leptochloa dubia* Nees.).—One square rod was planted June 7 from seed raised in the grass garden in 1899. It sprouted quickly, and the plants made a fine growth, reaching a height of 8 inches by the middle of July and of 2 feet by the 1st of August. A month later the grass stood 4 feet high, strong and healthy, and it was in full flower early in September. Owing to its isolated position, it was badly lodged by heavy winds. Seed was gathered October 5 and the plat mowed. Two weeks later a good aftermath was observed.

For softness and abundance of foliage and fineness of stem, this grass is unrivaled by any other which grows to the same size—5 feet or over. This I regard one of the most important grasses from the Southwest yet experimented with and have no hesitation in recommending its extended cultivation.

Large water grass (*Paspalum dilatatum* Poir.).—This valuable grass was sown May 23 on five fractional plats equivalent to 2 square rods. The seed, which was obtained from an eastern seed firm, germinated slowly, and not until the end of June were the plants above ground. During the remainder of the season growth was vigorous, and by the middle of October the plants were 3 feet high and strongly tufted. The basal and culm leaves made a dense growth of foliage 18 inches to 2 feet high, above which rose the naked flowering culms, on which the seed was nearly ripe. On November 17, after several heavy frosts, the foliage was injured but little and later seed was still ripening.

Another square rod planted on June 6 from seed gathered by the writer on the Red River in Louisiana in 1898 came up at the same time and grew a little more vigorously, ripening its seed at the same time.

This is one of the largest of the water grasses and has long been recognized as valuable for wet meadows and pastures in the South. It can be highly recommended and should be more generally used.

Jaragua (*Andropogon rufus* Kth.).—One square rod was sown June 6 with seed received from Brazil by the Section of Seed and Plant Introduction (No.

3891). It germinated fairly well and grew slowly during the hot, dry months of July and August. On the 20th of October the grass had reached a height of 4 to 5 feet, a luxuriant mass of long, soft, and flexible basal leaves, but with no sign of flowering culms. The foliage was killed by the early November frosts, but it is hoped that the roots will survive the winter and establish a permanent plat.

Dr. J. F. de Assis-Brasil in his work, "Cultura dos Campos," speaks of it as follows:

It reproduces itself readily both by seeds and creeping rhizomes. The stem grows to the height of 12 feet at the time of flowering. As the stems are at that time rather hard, it is best to pasture the meadows occasionally in order to keep down the flowering stalks. An analysis made by Dr. Trovassos indicates a higher percentage of protein and carbohydrates than in the best leguminous plants, but for the purposes of this note it is sufficient to say that this indigenous grass produces an extremely rich forage.

This grass may prove of great value in the South and Southwest.

Louisiana grass, carpet grass (*Paspalum compressum* Nees.).—One plat was sown May 23 with seed purchased by the Division in 1899 and presumably of the crop of that year. At the end of seven weeks, or by the middle of July, it had just begun to germinate. A second plat was sown on the 2d of June with seed secured in 1898. By the middle of July this presented a close, even growth about 2 inches in height, and this lead over the first plat was maintained throughout the season. In the middle of October the grass on both plats was about a foot high and both were in flower. A firm turf had been formed by the creeping stems, and the foliage on the erect culms was healthy and abundant.

Both plats were situated on rather low ground where the water stood longest after rains. In the South where this grass is native it grows abundantly on open hillsides in the pine barrens as well as in the lower and more shaded lands along the creeks and branches. It is valuable for lawns, and especially so for pastures.

Grapevine mesquite (*Panicum obtusum* H. B. K.).—Two plats were planted June 7. The seed did not germinate until late in July, when a thin stand appeared. During the rest of the season the growth was vigorous, the erect shoots reaching a height of 18 inches and producing considerable foliage. The stolons, or runners, were very abundant and extended from 5 to 6 feet in every direction, binding the soil very closely. The foliage was killed by frosts early in November.

It is native of the Southwest, extending into Mexico, and is worthy of experiment in those regions. A plat of this grass in the garden on the Department grounds has persisted for five years resisting the cold winters and making a good growth each summer.

Mitchell grass (*Astrebala pectinata* F. v. Muell.).—One plat was planted May 26 with seed received from Prof. J. H. Maiden, Queensland, Australia. It germinated readily and a fair stand was obtained. By the middle of July the strong, leafy plants were 12 to 15 inches high and the first heads were appearing. Two weeks later found the height increased to 2 to 2½ feet, and some of the seed was ripe. Production of seed continued throughout the season, the last being gathered October 20, at which time the plants were about 3 feet high and the foliage very abundant. Frosts in early November killed the foliage.

This grass is very highly regarded as a hay and forage plant on the interior plains of Australia. It is very productive, and the strong root system enables it to withstand long periods of dry weather; so that it should be of value in our Southwestern States. It should be noticed that most of the growth was made during July and August, which were exceedingly dry and hot months.

Button grass (*Dactyloctenium australianense* Scribn.).—Two plats were planted with seed received from Australia under the name of “Munyeroo,” or “Peta-charthes” grass. The grass on these two plats was identical in habit and appearance with the plants grown in the grass garden in 1896 from Australian seed and reproduced each year by volunteer seeding. Some of the grass garden seed of 1899 was planted on two near-by plats, but it was either washed away or most of it failed to germinate, as only a few weak plants appeared. The button grass was sown May 26, and by July 14 the circular prostrate tufts were a foot in diameter and loaded with flower heads. On July 30 the first gathering of seed was made. From that time until the plants were killed by frosts in November, seed was produced in great abundance and gathered at intervals of about two weeks. The diameter of the individual plants increased to about 18 inches.

Two adjacent plats, planted also on May 26, with a mixture of Australian grass seeds were found to contain a small *Panicum*, considerable *Eragrostis brownii*, and about half button grass. The rate of development during the season was very much the same as that of the plats just described. The single plants were, however, much larger, the branches being about 2 feet long and rooting strongly near the base, the whole plant being some 4 feet in diameter. The color was light green, and relatively much more foliage and less seed was produced than in the other plats. This should make it of more value as a forage plant and soil holder.

Button grass is a native of the hot and dry interior regions of Southern Australia, and it may be of great use in similar regions in this country.

Curly mesquite (*Hilaria cenchroides* H. B. K.).—Three plats were planted June 7 with seed gathered in 1897; germination was good and the growth was unchecked by dry weather. By the middle of July the grass was 2 inches high and the runners were abundant. Two weeks later the runners had reached a length of 2 feet or more, striking root every four or five inches and sending up sturdy new plants which filled all the vacant space between the original seedling plants and made a strong, close growth, excellent for pasturage purposes. The erect culms were about 6 inches high and in full flower. One plat was taken up in September and transplanted to the Division's exhibit on the Pan-American Exposition grounds at Buffalo, N. Y. The plants on the other two ripened seed about October 1, at which time the fruiting culms were nearly dead, but the basal portions and the young plants were still vigorous. This is one of the most valuable grasses of the cattle ranges of the Southwest, and its successful propagation by seed is of great economic significance.

Black heads (*Pappophorum nigricans* R. Br.).—This well-known Australian forage grass proved to be the chief ingredient of a package of seed of mixed sand grasses received from that continent through Prof. J. H. Maiden. It was planted May 23 on one of the driest plats on the grounds. Germination was prompt, and the growth continued without check during the dry months of July and August, when the plants reached their maximum size of a foot to 15 inches and were fruiting abundantly. The production of fresh growths of leafy branches and seeds was continued until stopped by the November frosts.

This grass is very highly esteemed for pasturage in the drier parts of Australia. It probably would never be valuable as a hay grass on account of its low, tufted habit, but it should prove a desirable addition to the pasture grasses of our drier regions.

A grass very closely resembling “Black Heads” both in appearance and habit of growth occurs on the cattle ranges of Arizona, where it is highly valued by cattlemen.

Grama grasses (*Bouteloua*).—One plat of Side-oats grama (*B. curtipendula* (Mx.) Torr.), one plat of Blue grama (*B. oligostachya* (Nutt.) Torr.), and two

plats of Bristly grama (*B. hirsuta* Lag.) were planted on May 21 on the highest ground of the field.

All three of these valuable gramas germinated rather poorly and the Bristly grama quite slowly also, but all were uninjured by the drought, and all made a vigorous growth and produced an abundance of both foliage and seed. Their value as native pasture grasses in the Southwest is well known.

Blue grasses (*Poa*).—Twenty plats were sown to different species of Poas, mostly from western seed. Some failed entirely, owing to poor seed, dry weather, and unsuitable soil. Others made a very satisfactory progress, considering the conditions.

The soil of the Flats can scarcely be considered suitable for testing the mountain grasses. Several plats planted with forms of Kentucky blue grass from Oregon and Washington gave very promising results. Six plats of Canada blue grass, of two different lots, made a good growth and are well established for another season.

Fescues (*Festuca*).—Nineteen different lots of fescues, comprising fourteen species, were planted June 7 and 8 on the lowest part of the field. Two lots of King's fescue (*F. Kingii* Scribn.) failed to germinate. Most of the smaller ones, such as forms of red fescue, sheep's fescue, and slender fescue, did not do very well. From a few scattering tufts to a meager half stand was secured, the growth ranging from 1 to 3 inches. Two plats of tall meadow fescue from Russia (S. P. I. Nos. 1180 and 1337) both came up well and grew slowly during the entire season, reaching a height of 1 foot. A plat of reed fescue (*F. arundinacea*), from grass-garden seed of 1899, made the best stand and greatest growth, about 2 feet. Two plats of rough fescue (*F. scabrella*) from seed grown at our grass station at Walla Walla, Wash., presented a fine stand and a vigorous growth of long, soft leaves, 12 to 18 inches in height. With a variety of hard fescue from the same source a fine stand was secured with a sturdy growth of 1 foot.

Palm-leafed panic (*Panicum plicatum* Lam.).—This ornamental grass was planted on June 2, from seed raised the previous year in the grass garden. The two plats were on very low ground and were wet for some time after planting. On one plat and part of the second the seed came up quickly, while on the remainder of the second it did not germinate for several weeks. Growth on the first was fairly constant during the season, and the plats presented a very pleasing appearance. By the middle of October the grass was 3 to 4 feet high and the long, slender panicles appeared. The folded or plicate leaves were 12 to 18 inches long, about 2 inches wide, and very handsome. The foliage was entirely killed by the first hard frosts.

Some roots have been potted with the intention of trying its value as a house plant. By proper trimming it may probably be made to resemble quite closely the common *Pandanus*. It is valuable as an ornamental grass.

SUMMER AND SOILING CROPS.

MILLETS.

More than 50 plats were devoted to the different kinds of millets, exclusive of pearl millet, which will be found in another place (p. 10). The millets are divided into three groups, the foxtail millets, the broom-corn millets, and the barnyard millets, each representing a different species with its varieties.

Foxtail millets (*Chaetochloa italica* (L.) Scribn.).—Thirty-one plats were seeded on May 17 and 18 to the different forms, Common millet, German millet,

Golden Wonder millet, and Hungarian millet. Except for a few which washed out and were later reseeded, very satisfactory results were obtained. The plants varied in height from 2 to 2½ feet for some of the common millets to 6 feet for some of the German and Golden Wonder millets. Fully one-third of them matured seed in from 75 to 78 days. These were chiefly Common millets. Most of the remainder matured in from 80 to 90 days. Three German millets took 103 days and one required 110 for ripening its seeds.

One plat of Common millet was badly affected by a leaf-spot disease, while a second one contained a number of smutted heads.

Broom-corn millets (*Panicum miliaceum* L.).—Eighteen plats of these millets were sown May 17 and 18. Most of the seed was secured through the Section of Seed and Plant Introduction from China, Russia, and Asia Minor. There were many decided differences observable in varieties grown in the different plats. The plants varied greatly in regard to the thickness, height, and amount of branching of the culms, hairiness, the size and habit of the panicle, and the time of maturing. Two of the largest, 3½ to 4½ feet tall, with large, slender, drooping panicles 10 to 14 inches long, were very slow in growth, the seed ripening August 7, eighty-one days from planting. One was from Asia Minor (S. P. I. No. 3665), the other from China (S. P. I. No. 3867). Another, similar in habit but smaller, from Russia (S. P. I. No. 1387), was equally slow. All of the remainder, including three from American-grown seed, matured between July 21 and July 25, or in from sixty-five to sixty-nine days from the time of seeding. On one plat only was any smut observed.

Barnyard millets (*Panicum crus-galli* L.).—The barnyard millets are cultivated forms of our common barnyard grass. Four plats were seeded on May 17 and 18. One (9-E-11) with 1899 seed from the Washington Experiment Station ripened on August 14, and one (9-E-2) with Russian seed (S. P. I. No. 2798) on August 10. Both grew to a height of three feet, but the Russian plant was much more slender in habit. Another (9-F-8b), sown with seed from the Division supply, was 4½ to 5 feet high by the 1st of August, but had produced no heads. It made a very luxuriant, leafy growth, but died about the end of September without having flowered.

SORGHUMS (*Sorghum vulgare* L.).

Two plats of brown dhoura (9-G-3 and 4), the second of which was mixed with yellow milo maize, gave good results. The plants grew 6 to 7 feet in height, producing an abundance of stocky, much-branched stems full of leaves. The short, stout panicles are both lateral and terminal. A plat (9-G-7) of white African millet sown with Texas-grown seed made a splendid growth of about 7 feet, with abundant foliage, the lower leaves 3 to 4 inches wide and 2 feet long. Several plats of sorghum grew from 8 to 9 feet tall and produced a most succulent forage.

TEOSINTE (*Euchlaena luxurians*).

Teosinte stands unrivaled for quantity of forage produced. Two plats (9-H-9-10) were sown May 21 with seed from France (S. P. I. No. 3024). By the middle of July it was 3 feet high, and on August 1 it had reached 6 feet in height and so luxuriant in growth that the rows, planted 3 feet apart, could no longer be distinguished. By October 15 it was 10 feet high and an almost solid mass of culms and foliage. The leaves were about 3 inches wide and 3 feet long and crowded on the stems, which were 1 inch in diameter. About November 1 the male flowers began to appear, but soon afterward frost killed the plants. Two adjoining plats, of which the label was unfortunately lost, made an equally satisfactory growth.

PEARL MILLET (*Pennisetum spicatum*).

One plat was planted May 18 with seed obtained from a Richmond, Va., firm. On July 14 a fine stand of plants 3 to 4 feet high was noted. By August 1 it stood 6 to 7 feet tall, very full of leaves, but with no heads. Two weeks later heads began to appear. On October 18 it was 10 to 12 feet high. The culms were much branched but rather slender in habit, and the slender, spreading branches gave the plants a bushy appearance.

Another plat (9-G-13) sown with seed received from College Station, Tex., presented a striking contrast. The plants were 8 to 10 feet high and much more strict in habit than the preceding. The culms were much branched at the top, but the branches were appressed and bore no spikes. The spikes on the central stems were erect and 10 to 16 inches long.

MISCELLANEOUS FORAGE PLANTS.

SALTBUSHES.

Seed of several native species were planted May 12, but after the heavy torrential rain of the 19th, none of the seed could be found; certainly none of it ever grew. Some of the Australian species and several *Kochias*, closely related plants from Australia, were also lost in the same way.

Australian saltbush (*A. semibaccata* R. Br.).—One plat (9-A-1) planted May 12 with seed from California (S. P. I. 3922) germinated quickly and well, and made excellent growth. On July 3 it was 8 inches high, and July 31, after a month of very hot weather, the branches had grown to be 12 to 16 inches in length. Growth continued throughout the season, the vines on October 17 being 3 to 4 feet long and making a dense mat about 6 inches in depth on the ground. This was the slowest to produce fruit of any species grown this year. On the date last mentioned hardly enough had been formed to pay for picking.

Three more plats were planted June 9—two with seed from the Division supply and one with the same seed as the plat just described. All were up by the 1st of July, and during that hot month each made a growth of about 1 foot, a rate maintained until the middle of October, when they had caught up with the plat sown a month earlier—at least in size and vigor, but had just begun to fruit.

Gray saltbush (*A. halimoides* Lindl.).—One plat (9-A-11) was planted on May 12 with seed from California (S. P. I. 3925). On June 9 the plants were 1 inch high; on July 3 they were 6 inches high, and on July 31 they were fine and vigorous, 12 inches in height. Two plats sown July 9 with seed from the same lot produced plants which were about 5 inches shorter than the preceding through the summer, but had reached an equal size by October 17, when all were robust, spreading bushes fully 2 feet high and loaded with the spongy fruits which had been ripening and falling to the ground in such quantities that a bushel was taken up from each plat at this time. The plants continued to fruit until nearly the end of November, when they were pulled.

Annual saltbush (*A. holocarpa* F. v. Muell.).—One-half a plat (9-C-10a) was sown May 16 with seed from the United States grass station at Abilene, Texas, 1899. Germination was prompt and growth was rapid. On July 3 the stout bushes were 6 to 8 inches high, and fruit on some was nearly full grown. August 1 they were 12 to 15 inches high, widely branching and full of fruit, some of which was ripe and falling off. The plants grew to be 16 to 18 inches

high and fruited abundantly until they were pulled, November 28. On October 17, 1½ bushels of fruit were taken up from the ground under the plants, and on November 28 about 1 bushel more was secured, the total yield being at the rate of 800 bushels per acre.

Slender saltbush (*A. leptocarpa* F. v. Muell.).—One plat (9-A-10) was planted May 12 with California seed (S. P. I. 3926). On June 9 the plants were 1 inch high, and on July 3 they were 6 to 8 inches high and beginning to spread out on the ground like the Australian saltbush, which this plant closely resembles. Two more plats (9-A-8 and 9) were sown June 9 with seed of the same number and made a similar growth, equaling those from the first seeding by the middle of October, when all presented a dense mat of prostrate vines 3 feet or more in length and fruiting abundantly. They remained unharmed by frosts until the end of November, when they were taken up for seed.

BURNET (*Poterium sanguisorba* L.).

A plat (9-C-11) was seeded on May 18, and on June 6 the first plants appeared. On July 3 they were 3 to 5 inches high, but their growth was checked by the heat and increased only 2 or 3 inches during the month. With the coming of the September rains they began a vigorous growth, and soon the plants had a diameter of about 2 feet and continued green and fresh until December 1.

RAPE (*Brassica napus* L.).

One plat (9-C-7) was sown May 16 with French seed (S. P. I. No. 1449), which germinated very quickly and by June 6 gave a good stand of healthy plants 3 inches high. On July 3 they were 1 to 2 feet high, strong and vigorous, the largest in flower. A second plat (9-A-14) started June 9, came up well, and grew rapidly at first, but was badly burned by the hot weather of July, standing only 6 to 10 inches high at the end of that month and making almost no growth later.

LEGUMES.

More than 200 plats were devoted to the experiments with leguminous plants, for the most part with seed obtained from abroad through the Section of Seed and Plant Introduction. The remainder were from the Division stock.

ALFALFA (*Medicago sativa* L.).

Fifteen different lots of alfalfa were sown. The seeds were grown in different parts of the United States, in the Argentine Republic, in Italy, France, and Bavaria, in Turkestan, Siberia, and China, and in Egypt. Some of them were planted on May 14, some on May 24, and some as late as June 22. The ground selected was on the highest and best-drained portion of field 9. All the seed germinated well, and the young plants made a vigorous start, but in the last days of June and during July they were badly burned by the intense heat. Growth was completely checked for over a month, and the uppermost leaves became yellowish and finally died. The comparative vitality of the plants in the different plats could best be judged by the way in which they recovered from their injury.

Two plats (9-B-3 and 6) sown May 24 with Arizona seed seemed less vigorous after the burning than did most of the others and were quite badly affected with spot disease. Plat 9-C-14 was sown June 22 with Argentine seed (S. P. I. No. 3507), and plats 9-C-17 and 18 were seeded the same day with No. 3508. On

July 3, when most of the early planted plats were burned badly, these were just germinating in excellent condition. By August 1 they were about 6 inches high and slightly burned. On October 18 they stood 12 to 15 inches tall, healthy and vigorous, some in flower, and with little or no spot disease to be found.

Four plats were sown May 23 with seed from Southern Europe. Plat 9-B-13 was planted with Italian seed, plat 9-B-14 with Bavarian seed, plat 9-B-15 with seed from the south of France, and plat 9-C-15 with seed from Provence, France. All were badly tip-burned early in July, and did not grow any more until the end of that month. On October 17 the Bavarian stood nearly 18 inches high, while the others were only 1 foot high, but all except the Italian were weak and dying. None were affected with spot disease except the Provençal, and that but slightly.

Plat 9-B-17 was sown May 14 with seed from Bokhara, Turkestan (S. P. I. 679). This suffered severely from burning and made only 1 foot of growth during the season. In October much spot disease had developed and the lower leaves were dying. Plat 9-B-5 was sown on May 24 with Samarkand seed (S. P. I. No. 1295). This made the same growth during the season as the last, but remained quite green until the last of November. Very little spot disease was observed. Plats 9-B-1 and 2, planted from the same seed on June 21, were just coming up on July 3 when most of the plats were badly burned. By the middle of October they were 14 to 18 inches high and quite healthy in appearance. Plat 9-C-4 was sown with seed of Turkestan alfalfa (*M. sativa Turkestanica*) (S. P. I. No. 1169). It was injured by heat as badly as any and recovered as slowly. The growth amounted to 12 inches by October 17, when the lower leaves were dying, but none was affected by spot disease.

Plats 9-C-5b and 6 were planted May 16 with seed from China (S. P. I. 1152). The results were the same as with Turkestan alfalfa. Plat 9-B-4, sown May 24 with Egyptian seed, was badly burned, but made good recovery, and reached a height of 12 to 18 inches by October 18, when it appeared vigorous and healthy. No spot disease was found upon it.

CLOVERS.

Only five species were grown this year. They were all planted on the lower part of the land, where they made a very satisfactory growth.

Alsike clover (*T. hybridum* L.).—Plats 10-F-5 to 7 were seeded May 29 with American seed. On June 11 the plants were just up and the stand was excellent. By the 1st of July it was about 6 inches high. During July the growth was considerably checked but the foliage remained healthy and bright. Increase in size commenced with the September rains. By October 16 it stood 12 to 15 inches high, flowering and seeding abundantly. November 17 it was still fresh and green, notwithstanding several frosts.

Crimson clover (*T. incarnatum* L.).—Five plats, 10-I-14 to 18, were sown on June 1 with seed from the Division supply. It was well up on June 11 and, except for a slight burning in July, maintained a steady healthy growth throughout the season, reaching a foot in height in October. On November 17 the plants showed no effects of the severe frosts.

Hungarian clover (*T. pannonicum* Jacq.).—Plat 10-F-2 was seeded to this May 29. Only a few plants appeared and made but a slow growth. By October 16 each plant was a sturdy tuft of crowded stems about 6 inches high. It seems perfectly hardy here for it was not injured by November frosts. It is a native to Southern Europe, where it is said to be much earlier than red clover but less relished by stock.

Mammoth clover (*T. medium* L.).—Two plats, 10-F-8 and 9, were planted May 29. This germinated quickly and grew well, showing but little effect of the drought. By October 16 the plants were 2 feet high and seeding well, but were beginning to die. November 17 the most of the foliage was dead but no injury had been done by frost.

Strawberry clover (*T. fragiferum* L.).—Plat 10-F-1 was sown May 29 with Russian seed (S. P. I. No. 1018). On June 19 the first plants appeared. These grew slowly during the summer, showing no injury by heat. On October 16 the plants were in vigorous healthy condition, 5 to 6 inches high, making a thick, close growth. No flowers were produced. November 17 a few of the younger, tenderer leaves were killed by frost but the mass of the foliage was not injured.

Bush clover (*Lespedeza* sp.).—Plats 10-F-14 and 15 were planted May 29 with Japanese seed of *L. sericea* Benth. (S. P. I. No. 3121). The plants came up thinly and grew steadily through the hot spell, reaching a height of 2 feet in October. The plant is perennial, erect, with slender ascending branches, short, sessile leaves and white flowers borne sessile on the main stem and branches, nearly hidden by the numerous small leaves. The stems are tough and woody, but aside from this the plant should make good forage if palatable.

Another species (*L. bicolor* Turcz.) called "Hagi" in Japan (S. P. I. No. 2923) was planted May 29 on plats 10-F-16 to 18. It grew very much as the preceding but attained to the larger size of 3 feet. This species is very much branched with longer silky leaves, and flowers in an open terminal panicle. It has much more foliage in proportion to the stems and branches and would make more and better forage. It is also a perennial. The leaves were mostly killed by frost in November, by which time most of the seed was ripe.

Bird's-foot clover (*Lotus corniculatus* L.).—A half plat, 10-G-3a, was sown with Russian seed (S. P. I. No. 1065) on May 31. Only a few plants came up, but by their prostrate habit they soon covered the surface of the ground. By August 3 the plants were about 18 inches across and buds were appearing. September 20 the plants measured 2½ feet in diameter and were covered with bunches of bright yellow flowers. A month later these had disappeared and the seed was nearly ripe. The younger leaves were killed by November frosts, but the plat still looked green and fresh.

This little plant is highly esteemed in Europe for use on light, sterile soils and in dry places. It has become naturalized in the Southern States. The foliage is relished by both cattle and sheep.

Swamp lotus (*Lotus uliginosus* Schkuhr.).—A two-thirds plat, 10-G-2b, of this was started with French seed (S. P. I. No. 1468) on May 31. A fair stand resulted and the plants grew slowly until the heat of July checked them for a time, burning the tender foliage somewhat. On September 20 they were 6 inches high, healthy, and beginning to flower. Growth continued but no seed set. Frost killed only the more delicate young leaves.

The swamp lotus is a native of northern Europe, where it is valuable for wet or swampy land. It has been used successfully in similar places in the northern United States.

Sulla (*Hedysarum coronarium* L.).—Plat 10-G-4 was planted May 31 with Division seed and plats 10-G-5 to 7 on the same date with French seed (S. P. I. No. 1518). A good stand of each was secured by June 11. July 6 the plants were about 3 inches high and noticeably affected by the dry weather, from which they recovered only slowly. In August rapid, vigorous growth commenced, and by October 16 they were over 1 foot high and quite healthy in appearance. November 18 found them 18 inches in height and but little injured by frosts.

PEAS AND BEANS.

Field pea (*Pisum arvense* L.).—Four lots of field peas were sown May 29. All were imported seed (S. P. I. No. 1173 and Nos. 1485, 1486, and 1487) from France and Russia. Only a thin stand was obtained, and while they did not appear affected by the drought, their growth was always slow. The vines finally attained a length of 18 inches to 2 feet and most of them flowered, but none ripened any seed. All died in the latter part of September. Many of them were affected by downy mildew.

Bitter flat pea (*Lathyrus sativus* L.).—Three plats (10-D-10 to 12) were planted on May 28 and two plats (10-E-13 and 14) on May 29 with Russian seed (S. P. I. 1175). The plants came up promptly and grew vigorously during the summer. The plants were 16 to 20 inches high by the end of July, with an abundance of flowers and some full-grown pods. By October 1 they were nearly all dead and the seed ripe.

This species has not been cultivated in this country to any extent, because the seeds contain an alkaloid which is said to be poisonous. It would probably be of some value in the Southwest.

Chicharaca (*Lathyrus tingitanus* L.).—Plat 9-D-13 was seeded on May 28 with seed from Algeria (S. P. I. No. 3289). Only a thin stand was secured, but the growth was very rapid. The plants were unaffected by the heat and drought and reached a length of 3 to 4 feet by the end of the season. They produced numerous flowers during July, but no seeds set and the pods did not develop. On November 15 the vines were still green and healthy in spite of several severe frosts. This species closely resembles the bitter flat pea, but grew much larger. It has not heretofore been cultivated in this country. It was introduced from Algeria, where it is used as a winter forage, and is said to be free from the poisonous properties found in so many of the flat peas. It is cultivated in the Canary Islands and Morocco also, and is said to be hardy in Southern France where exposed to a temperature of 26° F.

Winter flat pea (*Lathyrus cicer* L.).—Two plats (10-D-14 and 15) were planted on May 28 with seed from France (S. P. I. No. 1459). On June 5 a good stand appeared. By the middle of July the plants were 5 to 6 inches high and somewhat burned. Toward the end of the month they revived a little and made some new growth, but produced no flowers, and later died. It is used in Germany and France as an early spring forage.

Everlasting flat pea (*Lathyrus sylvestris* L.).—Two plats (10-D-3 and 4) were planted on May 28 with Russian seed (S. P. I. No. 2802), and a half plat (10-D-6a) with French seed (S. P. I. No. 1460). Both lots came up thinly and grew slowly but steadily, reaching a height of about 16 inches by October 15. On November 16 they were still fresh and green after several heavy frosts.

Improved everlasting flat pea (*L. sylvestris wagneri*).—Seed from France (S. P. I. No. 1461) was used in planting a half plat (10-D-6b). In growth and appearance it did not differ from the above. This plant has been widely praised as a valuable forage during recent years; but, it must be said, that experiments in various parts of this country do not establish its claim.

Gray milk-pea (*Galactia canescens* Benth.).—A half plat (10-G-2a) was planted May 31. The seed did not germinate until June 19, and then the growth was quite slow. On July 15 the seedlings were 3 inches high and bush-like in habit. By August 3 the twining branches were 6 to 8 inches long; September 20 their length had increased to 1 or 1½ feet, and a few flowers were out. On the 16th of October the fruit was well set and the plants still fresh. By the middle of November the plants had succumbed to the frosts without ripening more than a small part of the seed. It is native to the dry region from Texas westward, and for that part of the country should be valuable.

Chick pea, garbanzo (*Cicer arietinum* L.).—Four plats were sown May 28 with French seed 10-C-12 and 13 with S. P. I. No. 2137, and 10-C-14 and 15 with No. 2376. Plats 10-C-16 and 17 were planted with Morocco seed (S. P. I. No. 2977), which failed to germinate. Both lots of French seed germinated well and made rapid, healthy growth. By the end of July the vines were 1½ feet in height, nearly done flowering, and bearing an abundance of nearly full-grown pods. September 20 the vines were almost all dead, and the pods were then picked and thrashed, only to find that but few of them contained good seed. Some were empty, and many contained moldy, immature seed.

Green gram (*Phaseolus mungo* L.).—Plats 10-C-18 to 20 were planted May 28 with Russian seed (S. P. I. 1385). It germinated quickly and gave a fair stand by June 5. On July 12 the plants were 12 to 15 inches high. The leaves were considerably eaten by insects. July 27 the vines were very vigorous in appearance, 2 feet or more in length, and making a tangled mass of very leafy forage. Flower buds were appearing. On the 22d of September nearly half the seeds were ripe and were then gathered. The older leaves were beginning to wither. On October 15 the seed was all ripe, but the vines were still green. Twenty-five pounds of seed were produced.

Two-thirds of a plat (10-H-3a) was planted on June 1 with seed of what was called Chinese soy bean (S. P. I. No. 2873). Germination was very irregular, but a fair stand was finally secured. Its habit and appearance soon showed it to be the green gram. It made about the same growth as the one just described, but the vines died a little earlier.

Slender bean (*Phaseolus angustissimus* Gray).—Plat 10-D-1 was planted May 28 with seed grown in the grass garden in 1899. Only a few of the seeds germinated, but the plants grew rapidly, reaching a length of 3 feet by September 20 and twining on each other in the absence of other support. It was then in full flower. On October 15 the seeds were nearly ripe, and the vines were dying. This bean is a native of the Southwest and may be worthy of cultivation in that region. The slender, twining vines grow vigorously, are much branched, and produce an abundance of foliage and fruit, which should make good forage.

Lablab (*Dolichos lablab* L.).—Several varieties of this bean from Italy and Algeria were planted June 1 on low ground. They came up well and made a most luxuriant growth of vines during the season. None of them seemed injured or even checked by the drought. The long, running shoots reached a length of 8 to 10 feet and produced an abundance of flowers in September. Fruit was matured only on one or two of the dark-leaved, purple-flowered varieties. All were killed by the November frosts.

Lentils (*Ervum lens* L.).—Plats 10-F-19 and 20 were planted May 29 with seed from Smyrna (S. P. I. No. 3658). A fair stand appeared. On June 11 the plants were 2 to 3 inches high, and on July 16 the height was 6 to 8 inches. By July 27 they were badly twisted about by winds and were beginning to die. On September 20 they were entirely dead.

Seed (S. P. I. No. 1467) planted May 31 on plats 10-G-18 to 20 gave a good stand, but the plants grew very slowly, took on a dried and sickly appearance, and finally died after reaching a height of 4 inches. No flowers were produced. Plats 10-G-16 and 17, planted on the same date with No. 1466, gave scarcely better results. The plants grew a little taller and lived a little longer, but also produced no flowers.

On May 31 plats 10-G-13 to 15 were sown with seed (S. P. I. No. 1183) from India. On June 11 the plants were 2 inches high and the stand excellent. By July 16 the plants were flowering at a height of 6 inches. August 3 they were still flowering, though badly beaten down and covered by dirt. On August 27 they were entirely dead and the seeds ripe.

Velvet bean (*Mucuna utilis* Wall.).—Plats 10-F-10 and 11 were planted May 29 with seed from Florida (S. P. I. No. 4333) and plats 10-F-12 and 13 with seed from the Division supply. Germination was fairly prompt, the young plants appearing by June 11, but the stand was poor. By the middle of July the vines were 3 feet long and growing vigorously. On September 20 the plats presented a tangled mass of vines about 3 feet deep and running out for 8 to 10 feet on all sides—a most luxuriant growth. October 16 they were still growing with no sign of flowers. October 25 showed the more tender and exposed foliage killed by the light frosts and early in November all were dead.

Soy bean (*Glycine hispida* Maxim.).—Several lots of soy beans were planted June 2. The series of plats on which they were sown was intersected by a wet depression in which the plants were noticeably smaller and less healthy in color. As no lot was situated entirely in the depression, the comparative value of the tests was not impaired. There were some striking differences in the time of maturing and in size and habit also.

Seed of a variety from China (S. P. I. No. 2869) with light green leaves and blue flowers made a growth of nearly 3 feet and matured about September 12. The variety "Kaiyuski daiszu" from grass garden seed had also light green leaves, very much wrinkled, and white flowers. It matured at the same time.

A variety from Paris (S. P. I. No. 5039) produced rather slender plants with dark foliage. Fruit ripened September 20. This was called "Early Black."

Two Japanese forms (S. P. I. Nos. 4912 and 4913) were sturdy bush-like plants about 2½ feet high and ripened their seeds about October 10.

Another Japanese variety, called "Best Green" (S. P. I. No. 4914) produced stout, heavy plants which grew to be 3 feet high and matured very slowly. On October 16 the vines were yet fresh and green and the seed was not ripe. Most of it matured from November 7 to 13.

Two Chinese varieties, "Chin Pi Do" (S. P. I. No. 2871) and "Hêh Pi Do" (S. P. I. No. 2872) were planted May 31. The first grew to a height of 4 to 6 feet. The plants were at first erect but finally bent over from their own weight. On October 16 the fruit was well formed but not ripening, and the plants were still vigorous. On November 17 the frost had destroyed most of the foliage. Only a few of the seeds were fully ripe. The second variety reached a height of over 4 feet and matured a little earlier than the preceding.

LUPINES AND VETCHES.

Eight different lots of lupines were planted on May 29. The seeds of one were collected in Wyoming in 1898. The others were all secured in France and Russia by the Section of Seed and Plant Introduction. All were failures from the start, as not more than a dozen germinated on any plat, and most of these succumbed to the heat and insect attacks. Not more than a dozen plants on all the plats lived to produce seeds, of which the greater part were eaten by insects.

Thirty-six different lots of vetches, comprising fifteen different species, five native and ten foreign, were planted May 22, 26, and 28. The different lots of Giant Vetch (*Vicia gigantea* Hook.) and Stolley Vetch (*V. leavenworthii* T. & G.), both native species, failed to germinate, as did also one lot of *Vicia dumetorum* from France. Five different lots of horse bean (*V. faba* L.) resulted in a very poor stand of weak plants, which were badly injured by heat. The few plants which survived made a growth of 1½ feet and some produced flowers. Three lots of Narbonne Vetch (*V. narbonensis* L.) gave similar results. Two lots of the one-flowered vetch (*V. monantha*) gave fair stands, but the plants were dried up at the height of 5 inches. They recovered somewhat later, but made little

growth, spending the remainder of the season in dying slowly. Two lots of the Big-seeded vetch (*V. macrocarpa* Bert.) from France resulted about the same, but grew 10 inches high and persisted longer. It closely resembles Spring Vetch. Two lots of Narrow-leaved vetch (*V. angustifolia*) gave only a few small plants, which soon died. A half plat of the American vetch (*V. americana* Muhl.), planted with Wyoming seed of 1898, gave but a few plants, which made little growth, were badly eaten by insects, and finally died early in October.

Vicia Bivonea Rafin.—Plat 10-A-2 was planted May 22 with seed from Australia, 1897 (No. 23740 of Professor Maiden). A thin stand resulted, but the young plants grew finely, reaching 6 to 8 inches in height by July 12. They showed no sign of injury by the heat. By September 1 they were a foot high, forming a dense, tangled mass, but died soon after without producing flowers.

Black bitter vetch (*V. ervilia*).—One plat (10-A-20) planted May 29 gave a thin stand, as did plats 10-D-19 and 20 planted with seed from France (S. P. I. No. 1452). The plants grew slowly but did not seem affected by the heat. By October 15 the plants were a foot high and still green but had produced no flowers. This species is adapted to hot dry climates. It is cultivated in the Barbary States, where it produces large crops.

Scarlet vetch (*V. fulgens* Batt.).—Plats 10-B-11 and 12 were planted on May 28 with seed from France (S. P. I. No. 1514) and plats 10-B-13 and 14 with another lot (S. P. I. No. 4336) from the same source. In each case a thin stand was obtained. On July 12 each was 6 to 8 inches high, the first entirely healthy, the second somewhat burned at the tender tips. By the end of the month no difference could be observed between the two. On September 17 they were 1½ to 2 feet high, a healthy vigorous growth of slender, tangled vines. October 15 they stood about 3 feet high and showed no signs of flowering. On November 17, the vines, while matted down somewhat, showed no injury from the frosts. This annual comes from Algeria, where it is known as a rapid grower and is considered one of the most valuable forage plants.

Spring vetch (*V. sativa* L.).—Nine different lots of this vetch were sown, and the results in all cases were nearly the same. The stand was not more than one-half in any case. The young plants were healthy, but were soon checked by the hot weather and quite badly burned. They recovered slowly from this and made new growth, but were always feeble, reaching a final height of about 10 inches and none of them producing flowers. By the end of September most of the plants were dead.

Mogollon vetch (*V. exigua* Nutt.).—Plat 10-C-1 was sown May 28 with seed of the crop of 1897 and plat 10-C-2 with seed of 1898. About half the seed grew, and the young plants, like those of the wild vetch, grew slowly throughout the hot months and showed no actual injury. The plants lived until the middle of October, at which time they had reached a length of from 18 inches to 3 feet, but had produced no flowers. This plant is native to the Southwest from New Mexico to California.

Vicia hirsuta Koch.—Plat 10-A-3 was planted May 22 with seed of this vetch raised at Ophir, Wash., in 1899. A thin stand appeared, and on June 19 the plants were 1 to 2 inches high. July 12 found them 4 to 5 inches high, green and healthy, and with no sign of injury from the heat. On July 27 the plants, though no larger, were still uninjured, but subsequent growth was slow. September 17 showed a height of 7 inches, but no sign of flowers. On October 15 the plants were beginning to take on autumn colors. November 27, after several severe frosts, they were still alive.

This vetch is a native of Asia and has been sparingly introduced into this country from Europe.

Milk vetches.—The seeds of several native species of milk vetches from the Rocky Mountains and of two imported species were planted June 1. Of the natives only one germinated at all, and that produced but a half dozen plants.

Morton's milk vetch (*Astragalus Mortonii* Nutt?).—Plat 10-I-1 was sown with seed from the Division supply. Only a few came up, and these made but a slow growth, although they did not appear to be affected by the heat—at least the foliage was not injured. The plants are prostrate, forming round mats about three feet across. On November 17 they were still growing, after severe frosts, but had not flowered. This species is native to the Rocky Mountains and westward to the coast. It produces an abundance of foliage and may prove of some value in that region.

Astragalus falcatus Lam.—Two lots of French seed were sown June 1. Plat 10-I-4 was planted with S. P. I. No. 1448, and 10-I-6 and 7 with No. 5034. A thin stand was secured and a slow growth resulted. October 16 the plants were one foot high, fresh and healthy in appearance, but without flowers. November 17 they were unharmed by the heavy frosts. This species is native to the Caucasus, and may prove of value in the Rocky Mountain region.

Genge, rengeso (*Astragalus sinicus* L.).—Plat 10-I-5 was planted with seed from Japan (S. P. I. No. 3725). On June 11 a good stand had appeared. About July 1, when the plants were only two inches high, they were checked and burned by the heat, and recovered only slowly. October 16 the plat presented a very healthy appearance. The plants were then six inches high and a few clusters of blue flowers were out. November 17 flowers were still appearing, but the upper leaves had been killed by frosts. The rest of the plant was uninjured.

C. R. BALL,

*Assistant in charge of Grass Gardens and
Experiments within the District of Columbia.*

Approved:

JAMES WILSON, *Secretary.*

WASHINGTON, D. C., *December 13, 1900.*